Dec. 13, 1960 M. V. DADD 2,964,027

VALVE FOR METERING LUBRICATING OIL FROM A HYDRAULIC TAPPET TO A HOLLOW PUSH ROD

Filed March 19, 1958

Fig. 1.

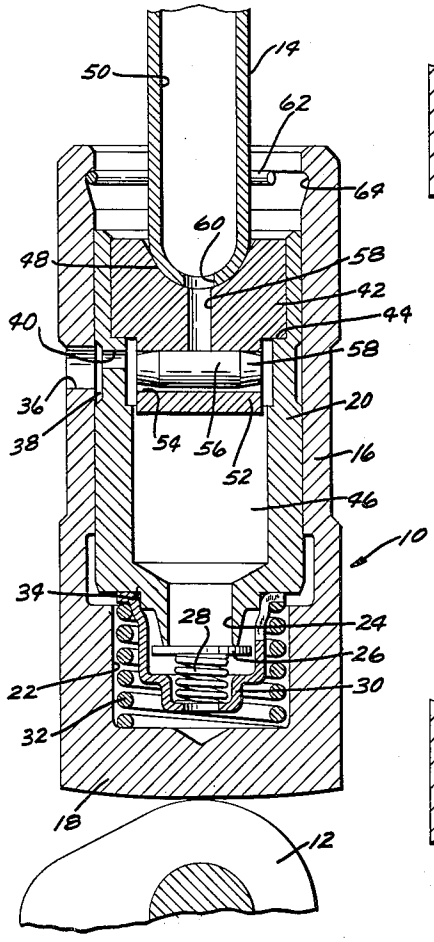


Fig. 2.

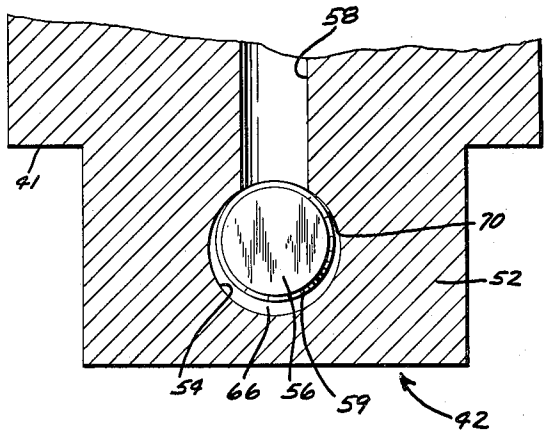
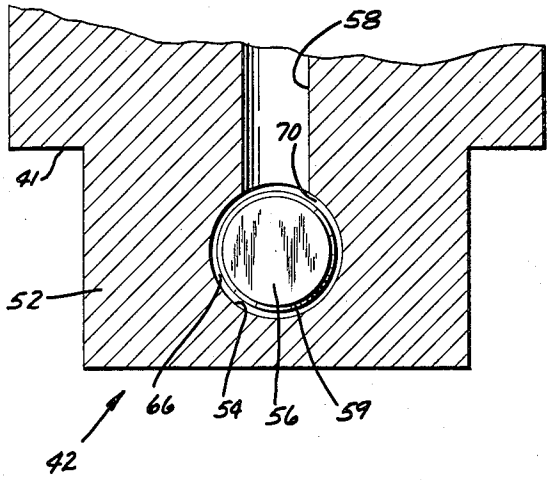


Fig. 3.



INVENTOR.
Morris V. Dadd

BY
Price and Heneveld
ATTORNEYS

United States Patent Office

2,964,027

Patented Dec. 13, 1960

2,964,027

VALVE FOR METERING LUBRICATING OIL FROM A HYDRAULIC TAPPET TO A HOLLOW PUSH ROD

Morris V. Dadd, Ada, Mich., assignor to Johnson Products Incorporated, Muskegon, Mich., a corporation of Michigan

Filed Mar. 19, 1958, Ser. No. 722,521

4 Claims. (Cl. 123—90)

This invention relates to engine lubrication systems generally and more particularly to means for lubricating engine valve actuating rocker arm assemblies.

The engine valves of many automotive and other type engines are operated by rocker arm assemblies which require some lubrication. Such rocker arm assemblies include a push rod member engaged between a rocker arm member and an hydraulic tappet. The hydraulic tappet rides on the valve timing cam in the course of its valve actuating operation. The tappet is supplied with hydraulic fluid from the engine lubricating system. One means of lubricating the rocker arms is through the push rod member. The rocker arm lubrication, however, does not require the full pressure lubrication which is connected to the hydraulic tappet. Thus a valve arrangement is required to be provided to meter hydraulic fluid from the hydraulic tappet through the push rod.

Previous valve arrangements for rocker arm lubrication from a hydraulic tappet have required pressed on retainers and other parts to provide a satisfactory metering check valve. Such parts are nonfunctional except for retaining the check valve in operating position. These nonfunctional parts are an added expense to provide and to assemble.

The metering valves which have been provided in hydraulic tappets are generally designed to operate within a certain range of engine oil pressures. The valves must accurately control fluid flow through the hollow push rods to prevent excess lubrication from reaching the rocker arm gallery since such excess lubrication is readily drawn into the engine combustion chamber about the engine intake valves and is lost. Consequently, a different metering valve has been required with engines having different engine oil pressures supplied to the hydraulic tappets.

It is an object of this invention to provide an improved means of properly lubricating an engine valve rocker arm. Such improved means includes one control valve for use with tappets receiving either full or partial engine oil pressure.

It is another object of this invention to provide a simple and inexpensive means of metering the proper amount of oil to the rocker arm assembly without requiring any nonfunctional parts such as pressed on retainers and the like.

Still another object of this invention is to teach a new and different means of restricting the flow of lubricant from an hydraulic tappet to the rocker arm member. Such means makes use of a hollow push rod member but includes a new and improved means of restricting the flow of lubricant from the hydraulic tappet to the hollow push rod member.

A further object of this invention is to provide a rocker arm lubrication means which may be incorporated within existing hydraulic valve lifters by a simple and inexpensive modification thereto.

A still further object of this invention is to teach a flow control or restriction means responsive to different

pressure conditions of the fluid to be restricted and to its viscosity. This includes consideration of both the relative proportion of the flow control parts and the materials used to form such parts.

It is proposed to have a cylindrical hole provided through the lower portion of the push rod seat or lifter member of an hydraulic tappet. Such hole is to intersect the passageway which communicates with the lubricating passage in the push rod. The hole is crosswise of the push rod seat, extending radially therethrough, and is within a part of the push rod seat which is disposed within the reservoir of the hydraulic tappet. A cylindrical pin is disposed within the cylindrical hole. The pin has a smaller external diameter than the internal diameter of the hole. The valve pin is prevented from horizontal movement by the plunger side walls next adjacent thereto and is retained against undue vertical movement by the part of the push rod seat below the center line of the hole. The valve pin is smaller than the diameter of the hole by an amount necessary for proper operation.

The same valving arrangement may be used in engines having only partial engine oil pressure directed to the lifter galleries as well as those having full oil pressure directed to the lifters. The valve functions properly in both types of oiling systems but functions differently in each in order to deliver the proper amount of oil to the lifter assemblies.

In the drawings:

Fig. 1 is a cross sectional view of a hydraulic tappet including the rocker arm lubrication metering system of this invention.

Fig. 2 is an enlarged cross sectional view of the push rod seat member as formed to include the features of this invention.

Fig. 3 is an enlarged cross sectional view of the push rod seat member showing the flow control valve pin of this invention in a different position than is shown by Fig. 2.

The hydraulic tappet disclosed by the drawings is one of generally conventional design. The tappet includes a tappet body having a hollow plunger disposed therein and forming a pressure chamber between the lower end thereof and the blind end of the tappet body member. A push rod seat or lifter member is disposed within the upper end of the plunger, closing the upper end thereof, and forming a reservoir chamber with the plunger. A passage within the lower end of the plunger provides communication between the reservoir chamber and the pressure chamber. This passage is closed by a check valve biased by a light spring held within a retainer cap engaged to the end of the plunger. The other spring within the pressure chamber serves to bias the plunger away from the blind end of the tappet body member. Passages through the tappet body and plunger member permit hydraulic fluid to enter the reservoir chamber. The different parts of the hydraulic tappet are retained within the tappet body by a snap ring received within a groove formed in the upper part of the tappet body member. The plunger member is axially adjustable within the tappet body member by leakdown occurring within the clearance space between the plunger and the tappet body member.

Referring to the drawings in further detail, there is shown an hydraulic tappet **10** disposed for engagement at one end by an actuating cam **12** and at the other end by a hollow push rod member **14**. The tappet member **10** includes a hollow tappet body member **16** closed at the lower end **18**. A plunger member **20** is slidably disposed within the hollow tappet body member **16**. A pressure chamber space **22** is formed between the end of the plunger member **20** and the blind end **18** of the tappet body member **16**. A passage **24** is formed

through the end of the plunger member 20 to provide communication between the interior of the plunger and the pressure chamber space 22. The passage 24 is closed by a check valve plate 26 held in engagement with the end of the plunger member by a light spring 28. A check valve retainer cap 30 is engaged with the end of the plunger member, within the pressure chamber space. A plunger return spring 32 is engaged between a shoulder 34 provided on the end of the plunger member 20 and the closed end of the pressure chamber space.

A passage 36 is formed through the side wall of the tappet body member 16. A peripheral groove 38 is provided around the plunger member next adjacent the passage through the tappet body side wall. A passage 40 is formed through the side wall of the plunger 20 from the peripheral groove 38. The tappet body and plunger passages 36 and 40 provide a means of communication for hydraulic fluid under pressure from an external source, such as the engine lubrication system, to the interior of the plunger member.

A push rod seat member 42 is received within the upper end of the plunger member 20. A shoulder 44 is provided within the plunger member 20 near its open upper end. The push rod seat member 42 includes a shoulder 41 received on the plunger shoulder 44. This closes the upper end of the plunger member and forms a reservoir chamber 46 within the plunger member 20. The upper end of the push rod seat member 42 is formed to include an approximately spherical seat 48. The push rod member 14 is engaged with the push rod seat member 42 within such spherical seat 48. The push rod member 14 is hollow and includes a passageway 50 through which lubricant may be conveyed from the hydraulic tappet 10 to the engine valve rocker arm assembly (not shown).

The push rod seat member 42 includes a boss 52 which extends within the reservoir chamber 46 of the plunger member 20. A cylindrical passage 54 is bored radially through the push rod seat boss 52. The ends of this passage are in open communication with the reservoir chamber 46. A cylindrical valve pin 56 is received within the passage 54. The valve pin 56 extends the full length of the passage 54. The ends of the valve pin are chamfered as at 59. The valve pin 56 has a smaller external diameter than the internal diameter of the passage 54. The resulting difference in the surfaces of curvature of the passage and the valve pin has significance as will be later described.

A passageway 58 is formed through the push rod seat member 42 from the spherical depression 48, formed in the upper end thereof, to the radial passage 54. The passageway 58 intersects the passage 54 intermediate its ends. A suitable opening 60 is provided in the end of the push rod member 14 to provide communication between the passageway 58 and the interior passage 50 of the push rod member.

The parts of the tappet member 10 which have been described, are retained within the tappet body housing 16 by a snap ring 62 received within a peripheral groove 64 provided about the upper end of the tappet body member 16 and internally thereof.

The cylindrical valve pin 56 is slightly smaller in diameter than the passage 54 by an amount necessary for its proper operation, as will be described. Such difference in size provides a clearance space 66 between the valve pin and the walls of the passageway. Such clearance space 66 is filled with the hydraulic fluid of the reservoir chamber 46. The valve pin 56 is made of a light weight material so that it is normally more responsive to fluid pressures than to inertia forces resulting from the rapid reciprocation of the tappet member. In addition, the valve pin 56 is formed from a material having a heat of expansion or coefficient of expansion, which is greater than that of the push rod seat 42. Both of these factors cause a difference in the restriction of fluid flow through the passageway 58 under different engine oil pressures and as the engine warms up and the viscosity of the lubricant becomes less. This is best shown by describing the operation of the fluid flow control.

Operation

The hydraulic tappet 10 just described, including the fluid flow metering device of this invention, is suitable for use with engines having either full engine lubricating pressure supplied to the tappet or having only partial engine lubrication pressure connected thereto.

In either instance, the tappet operation is the same and is as conventionally known. The tappet disclosed operates on the leakdown principle of having hydraulic fluid escape through the clearance space between the outer periphery of the plunger member 20 and the inner periphery of the tappet body member 16. The reservoir chamber 46 is at all times in communication with the reservoir chamber supply force through the passageways 36 and 38 provided through the plunger and tappet body walls.

Fig. 2 discloses the position of the valve pin 56 to restrict the flow of fluid to an external source, via the push rod member 14, with full engine oil pressure supplied to the hydraulic tappet member. With full engine oil pressure supplied to the reservoir chamber 46 the valve pin 56 is held against the top of the rod seat passage 54 and engaged over the passage end of the outlet flow passageway 58. The difference in the surface of curvature of the passage 54 and of the valve pin 56 provides an orifice 70 between the peripheral surface of the cylindrical pin and the side of the push rod seat wall through which the passageway 58 is formed. Full engine oil pressure is sufficient to hold the valve pin 56 up against the valve seat under all normal engine operating conditions. Thus, the orifice 70 is the difference of the radii of the contacting parts. The valve pin 56 is made of a material of such weight that it is not heavy enough to be unseated at any time during normal tappet operation, under full pressure conditions to the tappet.

The oil metering system is somewhat different in an engine having only partial engine pressure supplied to the tappet member 10. Referring to Fig. 3, in such case the oil pressure is not great enough to hold the valve pin 56 against the upper side of the passage 54, which is the valve seat in the vicinity of the vertical passageway. Under the condition of only partial engine pressures the weight of the valve pin 56 is also more responsive to inertia forces due to the movement of the tappet on the actuating cam 12. Consequently, the valve pin 56 may be pulled away from the valve seat during each engine valve operating cycle. Thus, the valve orifice 70 becomes essentially the diametrical clearance between the valve pin 56 and the valve passage walls; as shown in Fig. 3.

Accordingly, it will be appreciated that under full engine oil pressure conditions the supply passage 58 to the rocker arm 14 is more fully restricted, though not cut off, than under conditions of only partial engine oil pressure. The disclosed means for metering the flow of lubricant to an external source, from a hydraulic tappet, is responsive to the fluid pressure condition from the pressure supply source. Furthermore, the disclosed metering valve is automatically responsive to any change in the pressure condition at any time.

In addition to the responsive nature of the disclosed metering valve to different engine operating pressures, other means are provided for varying the metering orifice. Such means are responsive to changing temperature conditions as the engine warms up and causes the fluid to become thinner as its viscosity is lowered. This includes having the valve pin 56 made of a material which has a greater heat of expansion than that of the push rod seat 42. As a result the valve pin 56 changes in diametrical size during temperature increases. This results in the flow orifice 70 being more completely restricted by the valve pin 56 as the engine warms up and the engine oil becomes thinner. Consequently, much better

oil flow control is provided at high engine speeds and loads than would otherwise be attained.

While a preferred embodiment of this invention has been described, it will be understood that other modifications and improvements may be made thereto. Such of these modifications and improvements as incorporate the principles of this invention are to be considered as included in the hereinafter appended claims unless these claims by their language expressly state otherwise.

I claim:

1. A metering valve for use within hydraulic tappets to control the flow of hydraulic fluid through the push rod seat member thereof to a hollow push rod member engaged therewith, and including: said push rod seat having one end thereof received within the reservoir chamber of said tappet, a passage formed radially across and through said push rod seat end, a passageway formed through said push rod seat intermediate the ends of said passage and for communication with said hollow push rod member, and a valve pin received within said passage and extending between the ends thereof, said valve pin having a smaller surface of curvature than said passage for only partially restricting said passageway when engaged over the end thereof, and said valve pin having a coefficient of expansion greater than that of said push rod seat member for enlarging said valve pin and more fully closing said passageway under high temperature conditions reducing the viscosity of said fluid.

2. A metering valve for use with hydraulic tappets to control the flow of fluid from a pressure supply source to an exterior source, and comprising: a valve housing is connected to a pressure supply source, a passage formed through said housing and having a valve pin received therein, said valve pin having a smaller diameter than

that of said passage, and a passageway formed through said housing from said exterior source to and between the ends of said passage, said valve pin being engaged over the end of said passageway by the fluid pressure conditions within said passage and reservoir for restricting the flow of fluid therethrough, and said valve pin having a coefficient of expansion greater than that of said housing for more adequately restricting said passageway under temperature conditions lowering the viscosity of said fluid.

3. In a fluid flow metering valve, the method of varying the restriction to fluid flowing therethrough in accord with a change in the viscosity of the fluid due to changing temperature conditions, comprising: having the valve seat and valve members of different coefficients of expansion for changing the clearance therebetween in accord with temperature changes altering the viscosity of the fluid.

4. In a fluid flow metering valve including a valve and valve seat member, the method of varying the restriction of fluid flow therebetween in accord with changing temperature conditions altering the viscosity of said fluid, and comprising: forming said valve member of a material having a greater coefficient of expansion than said valve seat member for changing the clearance therebetween in accord with temperature changes affecting the viscosity of said fluid.

References Cited in the file of this patent

UNITED STATES PATENTS

2,163,969	Whalen	June 27, 1939
2,705,482	Randol	Apr. 5, 1955
2,818,050	Papenguth	Dec. 31, 1957